

Animation Brings Science to Life

COMMUNICATING complex scientific and technological concepts to a variety of audiences may seem daunting to some, but for Lawrence Livermore animator Michael Loomis, it is all in a day's work. Through animation, Loomis helps scientists and engineers effectively explain their ideas and research to peers, colleagues, laypeople, and decision makers. He blends his knowledge of computer science, art, and communications to create technically accurate, aesthetically pleasing visualizations that bring science to life. Loomis's work shows how visual representations are critical in making technical material accessible to broad audiences.

Loomis started at the Laboratory 15 years ago as a computer programmer in the Computation Directorate. While working on projects with the Engineering Directorate, he discovered that scientists and engineers need visual tools to explain their research. He seized the opportunity and was soon producing animations full time. Today, he is the primary animator for the Engineering Visualization Theater, a production studio and presentation facility at Livermore. Working with the same software filmmakers use to render an animated feature, Loomis constructs original designs or imports material, such as computer-aided design (CAD) models or simulation data. He then develops raw images and pieces them together to generate a video.

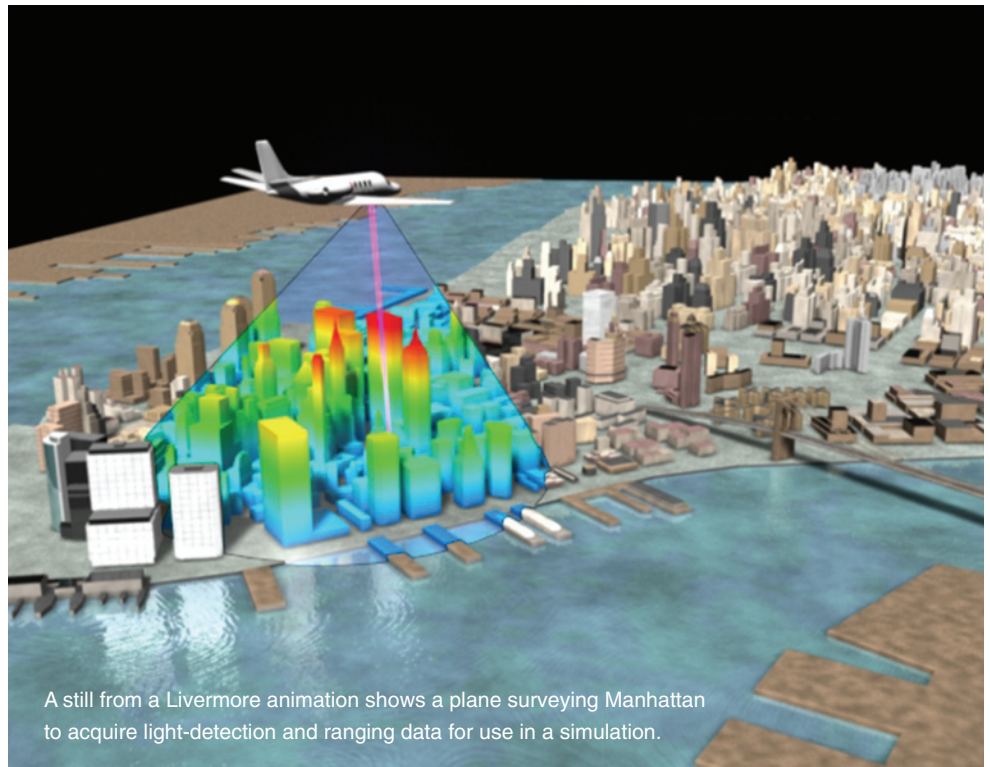
Explaining Simulations

Loomis works on a range of projects with researchers throughout the Laboratory. Using blueprints from 1936, he re-created a three-dimensional model of the San Francisco–Oakland Bay Bridge to produce a fly-by animation, giving viewers the perspective of flying over the bridge from one side to the other. This animation provided a context for a series of simulations examining how earthquakes might affect large structures. In a separate research project, Loomis used animation to describe results from a simulation of seismic activity at the Morrow Point Dam in Colorado.

This fly-over view of the San Francisco–Oakland Bay Bridge is included in a series of earthquake simulations. Livermore animator Michael Loomis used blueprints from 1936 to re-create the bridge's structure in three dimensions.

That simulation, developed for the U.S. Bureau of Reclamation, analyzed how dams might respond to earthquakes. (See *S&TR*, June 2007, pp. 17–19.)

Livermore's National Atmospheric Release Advisory Center turned to Loomis to explain how atmospheric scientists are using



A still from a Livermore animation shows a plane surveying Manhattan to acquire light-detection and ranging data for use in a simulation.

the Adaptive Urban Dispersion Model to simulate hazardous material dispersions in urban areas. The animation illustrates the process by which the model's grid-generation program uses light-detection and ranging data from aerial surveys to create three-dimensional meshes of cityscapes such as Manhattan. It then shows how a computer simulation uses these meshes and up-to-date data from weather satellites to predict where materials will disperse through a particular area. Results from such simulations help researchers accurately predict the spread of airborne hazards.

Animated Support for National Security

Loomis has created several animations for projects that support the Laboratory's national security mission. One animation profiles a gas-gun experiment at the Joint Actinide Shock Physics Experimental Research (JASPER) Facility in Nevada. The 30-meter-long, two-stage gas gun tests how plutonium reacts under extreme pressures and temperatures. Data from such experiments are used to determine plutonium's equation of state (which expresses the relationship between pressure, density, and temperature) to help researchers understand the effects of aging on the nation's stockpile.

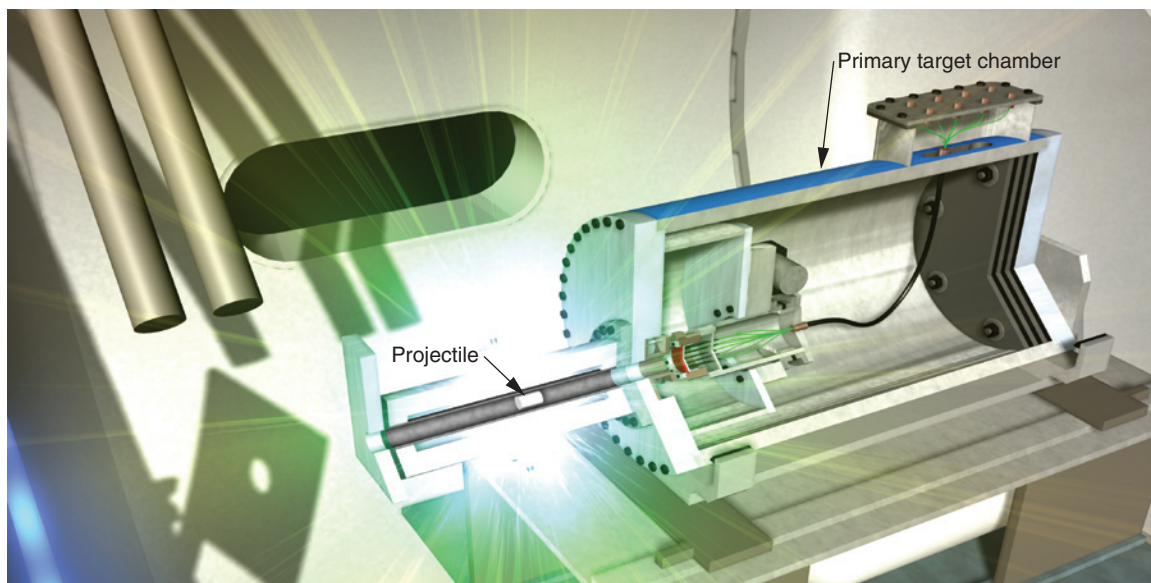
"Animation allows audiences to see a process in more detail," says Loomis. "It shows areas of diagnostic equipment or physical processes that are normally hidden from view in a standard

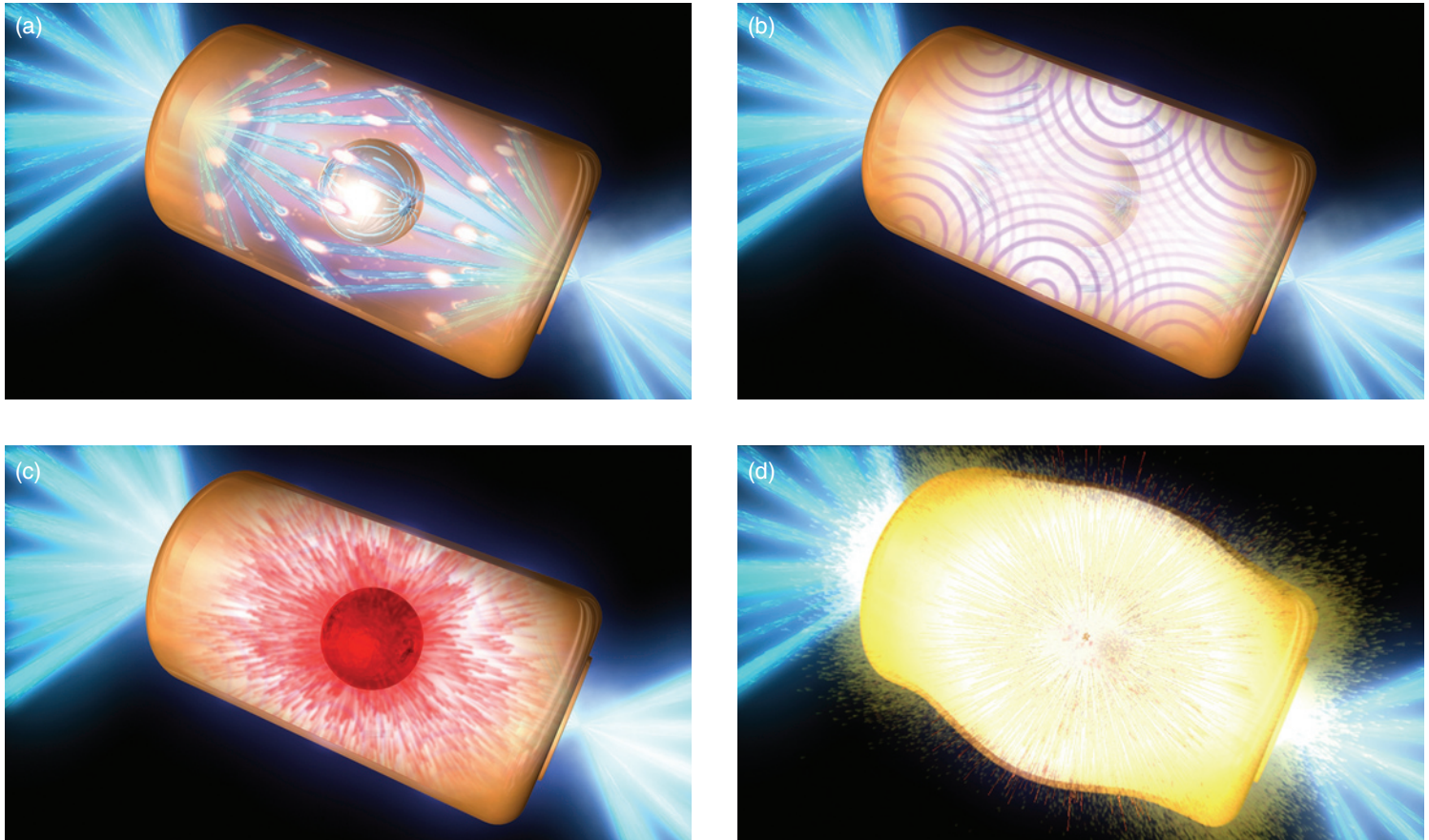
video." For example, in the gas-gun animation, viewers can "see through" the gun's outside structure to observe its inner workings, as if looking through an x-ray lens. They can watch step-by-step as the gas gun fires a projectile down the launch tube into the primary target chamber, where it impacts a plutonium target. This animation helps visitors to the JASPER Facility understand how the technology works.

Loomis continues to work with programs that directly support stockpile stewardship. Currently, he is developing animations for technical videos on the National Ignition Facility (NIF). NIF will provide researchers with a laboratory in which they can study the physical processes occurring in stars, planets, and exploding nuclear weapons.

Bryan Quintard, a Livermore photographer and videographer working with Loomis on the NIF videos, says, "These animations will allow us to see NIF in action. Michael is able to animate in a real sense what is happening with laser and light." The videos will help audiences visualize processes never seen before, such as the fusion reaction that will occur when NIF's 192 lasers strike a fuel capsule inside a tiny metal case called a hohlraum. In another video, whimsically referred to by Loomis as "NIF—The Ride," viewers will be put in the "front seat" of a laser beam as it travels through the laser bay and into the target chamber.

This cutaway view of the gas gun at the Joint Actinide Shock Physics Experimental Research Facility shows a projectile (white) being launched toward the primary target chamber.





Stills from an animated video of the National Ignition Facility (NIF) illustrate the fusion reaction that will occur when all 192 lasers are fired at a target inside a hohlraum. (a) Laser beams enter the hohlraum in the first one-billionth of a second (1 nanosecond) and (b) create x rays within 10 nanoseconds. (c) At about 15 nanoseconds, the target begins to implode. (d) NIF achieves fusion ignition by 20 nanoseconds.

Ten years ago, Loomis had to use conceptual drawings to develop animations of the NIF laser bay. Today, he can create far more realistic visuals using CAD drawings and working in high definition. When completed, the videos will effectively portray NIF's scientific capabilities and help scientists explain results from the first NIF experiments.

Loomis's work has been instrumental in helping scientists and engineers communicate their research. With his animated videos, audiences from various backgrounds can visualize complex processes and better understand how technologies work. As

science and technology continue to advance, the capability to visually explain new breakthroughs is not just an advantage, it's a necessity.

—Caryn Meissner

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For further information contact Michael Loomis (925) 422-0364 (loomis3@llnl.gov).